

Buckling Analysis of Open-Top Bridge Trusses

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Abstract

Finite Element Analysis (FEA) is a computerized method for determining the behavior of engineering elements under various loading and environmental conditions. Models can be comprehensively generated and sectioned into finite elements and the software can determine important stages such as buckling and failure of the structure. Computer based FEA offers significant benefits by cutting down cost and time to perform analysis on complex structures. In this research, the powerful software Abaqus is used to make models and perform buckling analyses for Half-Through trusses as specified by American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications. Some of the structures that can benefit from this analysis are steel pedestrian bridges. Using the analogy of beam on elastic foundation, Timoshenko, a pioneer in structural engineering, derived a mathematical equation for calculating the critical buckling load caused by the compressive load on the top chord, in terms of buckling length coefficient, rigidity of members and intensity of axial load. However, research on this topic is limited in the literature and further study is needed. The goal of this research is to enhance, to expand, and to examine the behavior of trusses in detail. The task includes performing analysis on the buckling of the top chord for out of plane instability of Half-Through trusses with varying "n-panels", and varying L, length of top chord, and H, height of vertical member of the truss. This paper attempts to find factors influencing the critical buckling of top chord of trusses. It is also intended to continue this study in a second phase by constructing structural system prototypes in the laboratory. Each structural system will be tested, and the results from laboratory testing will be compared with the results from an identical computer simulation to further validate the computer-based modeling procedures.

Keywords: Structures, Analysis, Buckling, Half-Through Trusses, Timoshenko, AASHTO, Abaqus